6 SURVEILLANCE AND MONITORING

INTRODUCTION

The effectiveness of a water quality control program cannot be judged without information supplied by comprehensive surveillance and monitoring of water, sediment, aquatic resources, and the human activities that have the potential to impact beneficial uses. The following section describes the monitoring programs that together provide high quality, comprehensive scientific information on water quality in the San Francisco Bay region. The Regional Board uses information produced by the programs described below to satisfy the requirements of Sections 104, 106, 208, 301, 303, 304, 305, 307, 308, 314, and 402 of the federal Clean Water Act and applicable portions of the state's Porter-Cologne Water Quality Control Act.

REGIONAL MONITORING PROGRAM

The Regional Monitoring Program forms the core of water and sediment quality monitoring in the San Francisco Estuary. Historically, water quality in the region was tracked by Regional Board and State Board research and monitoring programs and numerous studies carried out by other interested state, federal, and local agencies.

In 1993, the Regional Monitoring Program (RMP) was formally established to provide integrated, comprehensive, and systematic information on water quality in the region. Its goal is to evaluate the effectiveness of the Regional Board's water quality program in meeting Basin Plan objectives, including protection of beneficial uses in the San Francisco Estuary. The Regional Monitoring Program's specific objectives are to:

- Obtain baseline data and continue development of a data set that describes the concentration of toxic and potentially toxic trace elements and organic contaminants in the water and sediment and long-term trends in these concentrations;
- Determine seasonal and annual trends in chemical and biological water quality;
- Determine whether water quality and sediment quality in the Estuary at large are in compliance with the Basin Plan; and
- Provide a data base on water and sediment quality compatible with data being developed in other ongoing studies in the region, such as wasteload allocations, model development, sediment quality objectives, in-bay studies of dredged material disposal, primary productivity studies, local effects biomonitoring programs, and state and federal Mussel Watch programs.

The 46 federal agencies, local special districts, and private companies that hold Regional Board permits for waste discharge into the Estuary sponsor the Regional Monitoring Program. The San Francisco Estuary Institute (formerly the Aquatic Habitat Institute), an independent nonprofit organization, administers and manages the program under a Memorandum of Understanding with the Regional Board.

The design of each study component of the RMP draws directly from results of short-term, intensive pilot studies. Between 1989 and 1992, the Regional Board conducted a number of these studies, including determination of background levels of toxicity and water and sediment chemistry in different basins; critical habitat investigations to determine if high levels of contaminants were present in sensitive areas around the Bay margin; an in-depth analysis of sediment toxicity testing along a contaminant gradient; and an assessment of the temporal, spatial, and species-related variability of bivalve pollutant bioaccumulation

In 1993, the RMP sampled at 16 locations over three seasons (wet, dry, and spring peak riverine flow) for conventional water quality parameters and chemistry, water toxicity, sediment quality and chemistry, sediment toxicity, and bivalve bioaccumulation (Figure 6-1). Table 6-1 lists the trace metal and organic

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compounds analyzed for in the RMP. Pilot studies conducted in 1993 include plankton community spatial and temporal variability and suspended sediment dynamics.

To complement the system-wide Regional Monitoring Program, intensive surveys of limited areas are often conducted. This monitoring is typically done to evaluate specific contamination or beneficial use problems, such as cases where receiving water quality objectives have been violated.

Full implementation of the San Francisco Estuary Project's *Comprehensive Conservation and Management Plan* and the state Bay Protection and Toxic Cleanup Program will involve two elements:

- Initiating new monitoring elements in the RMP, such as identifying sediment reference sites, tracking contaminant levels in fish caught for food, and monitoring wetlands; and
- Ensuring closer coordination between the RMP and other major programs, such as the Interagency Ecological Studies Program (IESP) and the Long Term Management Strategy for Dredging (LTMS), including monitoring conducted by citizen volunteers in ongoing work.

STATE MUSSEL WATCH AND TOXIC SUBSTANCES MONITORING PROGRAMS

In 1976, the state initiated the State Mussel Watch and State Toxic Substances Monitoring Programs to regularly monitor the concentration of pollutants in the tissue of aquatic organisms. Tissue levels reflect exposure over much longer periods of time than instantaneous water column samples and provide a field-based estimate for exposure of people, fish, and wildlife to pollutants in the food chain.

The Mussel Watch Program uses resident and transplanted bivalves to monitor pollutant levels at coastal reference stations and selected sites in bays and estuaries to confirm potential toxic substance pollution. The location and sampling history of Mussel Watch stations in the San Francisco Bay Region are summarized in Figure 6-2 and Table 6-2. Periodic monitoring of bivalve tissue conducted by the National Mussel Watch administered by the National Oceanic and Atmospheric Association (NOAA) and international surveys complements information from the State Mussel Watch Program.

The Toxic Substances Monitoring Program uses resident fish and other aquatic organisms to monitor pollutant levels in freshwater systems throughout the state. The location and sampling history of Toxic Substances Monitoring stations in the region are summarized in Figure 6-3 and Table 6-2.

SACRAMENTO-SAN JOAQUIN RIVERS AND NORTHERN SAN FRANCISCO BAY ESTUARY WATER QUALITY SURVEILLANCE

Water flowing into the San Francisco Estuary from the Sacramento and San Joaquin rivers is regularly monitored by numerous agencies and programs, including the Sacramento Coordinated Water Quality Monitoring Program (in the Sacramento metropolitan area), the Department of Water Resources, the Central Valley Regional Water Quality Control Board, and the Interagency Ecological Studies Program. Conventional water quality parameters, water and suspended material chemistry, and toxicity are sampled at a network of stations located throughout the Delta and into San Pablo Bay. In addition, phytoplankton, benthic community, and beneficial use surveys are regularly conducted in this area.

The primary goals of these efforts are to: (a) assure riverine water quality meets applicable standards; (b) identify changes in water quality potentially related to the operation of the State Water Project; and (c) develop technical information that can be used to estimate mass loading of pollutants to the Estuary from riverine sources.

GROUNDWATER MONITORING NETWORKS

Groundwater monitoring networks are established in several basins in the region. At present, there are networks in Livermore Valley, Niles Cone, Santa Clara Valley, Half Moon Bay Terrace, and Napa Valley. In order to find out the most current status of these networks, local water management agencies should be contacted directly. In addition, the U.S. Geological Survey and state Department of Water Resources maintain regional monitoring networks. Typically, monitoring is conducted at least annually for general mineral quality and water levels. This well data may be of use to determine the general potability of groundwater and the status of sea water intrusion control. The Regional Board is integrating the locations of monitoring well networks into its groundwater geographic infor-

mation system. The water quality data generated from the networks will assist Regional Board staff in the refinement of beneficial use designations for groundwater basins.

COMPLIANCE MONITORING

A second component of the state's water quality surveillance and monitoring program relates specifically to discharges of pollutants at individual point and nonpoint sources. All entities holding Regional Board discharge permits must conduct regular sampling and analysis of waste released to surface and groundwaters. They must also analyze material to be dredged. The specific chemical and physical parameters, types (i.e., toxicity tests, bioaccumulation studies, waste stream sampling, etc.), frequency, and other information requirements are determined on a case-by-case basis according to the nature of the discharge and potential environmental effects. Each permit issued by the Regional Board describes the specific compliance monitoring requirements for that permit holder. Monitoring data collected by point source dischargers and nonpoint pollution control programs are used to:

- Determine compliance with and provide documentation to support enforcement of permit conditions;
- Support derivation of effluent limitations and wasteload allocations; and
- Provide information needed to relate receiving water quality to mass emissions of pollutants by dischargers.

Self-monitoring data are often supplemented by information obtained by Regional Board staff during site inspections (including waste analyses) and through special studies, such as those characterizing the variability of the discharge, pollutant levels in nearby receiving water and biota, and characterization of pollutant loads attributable to urban runoff.

COMPLAINT INVESTIGATION

The Regional Board encourages members of the public to alert it to pollutant discharge or nuisances that may impact water quality. Staff respond to each complaint, document the observed conditions, and take any necessary follow-up actions to institute appropriate corrective measures.

BIENNIAL WATER QUALITY INVENTORY

The Regional Board prepares a biennial report on water quality (as required under Section 305(b) of the Clean Water Act, PL 92-500). This report includes (a) a description of the water quality of major navigable waters in the state during the preceding years; (b) an analysis of the extent to which significant navigable waters provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife and allow recreational activities in and on the water; (c) an analysis of the extent to which elimination of the discharge of pollutants is being employed or will be needed; and (d) an estimate of the environmental impact and the economic and social costs necessary to achieve the "no discharge" objective of PL 92-500, the economic and social benefits of such achievement, and an estimate of the date of such achievement. Recommendations as to the programs that must be undertaken are provided, along with estimates of the cost.

OTHER MONITORING PROGRAMS

In addition to the state's surveillance and monitoring program, several other agencies in the Bay Area monitor water quality, including local city and county offices, federal agencies, and water supply districts. Local universities also conduct research and monitoring activities. All of these programs provide additional information and data that enhance the state's efforts.

TABLE 6-1 PARAMETERS ANALYZED FOR IN THE REGIONAL MONITORING PROGRAM

Water Quality Parameters	Sediment Quality Parameters
Temperature	Percent Fine (<63 µm dia.)
Salinity	Eh
Dissolved Oxygen	pH
pH	Temperature
Total Suspended Solids	Total Organic Carbon
Dissolved Organic Carbon	Total Nitrogen
Total Chlorophyll	
Phaeophytin	
Dissolved Phosphates, Silicates, Nitrate, Nitrite, and Ammonia	

Trace Elements in Water, Sediment, and Biota	Trace Organics in Water, Sediment, and Biota	
Aluminum	**Petroleum Compunds**	**Synthetic Biocides**
Arsenic	Alkanes, n-C12 to n-C32	Hexachlorocyclo-
Cadmium	Phytane	hexanes
Chromium	Total saturated and	Chlordanes (incl.
Copper	aromatic hydrocarbons	heptachlor epoxide)
Cyanide	PAHs	DDTs
Iron	Anthracene	Dieldrin
Lead	Fluoranthene	Endosulfan
Mercury	Pyrene	Chlorpyrifos
Nickel	Benzo(a)anthracene	Dacthal
Manganese	Chrysene	Diazinon
Selenium	Benzo(b)fluoranthene	
Silver	Benzo(k)fluoranthene	**Nonbiocide Synthetics**
Tributyltin	Benzo(a)pyrene	Hexachlorobenzene
Zinc	Benzo(e)pyrene	Polychlorinated
	Indo(1,2,3-c,d)pyrene	terphenyls
	Dibenzo(1,h)anthracene	PCBs, total and
	Benzo(g,h,i)perylene	selected congeners
	1-methylphenanthrene	
	Total methylphenanthrenes	

TABLE 6-2 KEY TO FIGURE 6-2 STATE MONITORING NETWORK

State Mussel Watch Stations

Code	Station	Sampling History
M1	Tomales Bay	1979-82;1991
M2	Point Reyes	1977-78;1991
M3	Suisun Bay	1987
M4	Bolinas	1980
M5	Concord/Pier 4	1987
M6	Concord/Seal Island	1987
M7	Selby Slag 4	1988
M8	Selby Slag 5	1988
M9	Selby Slag 6	1988
M10	Selby Slag 7	1988
M11	Mare Island	1985;1987-88
M12	Davis Point	1980;1982;1988
M13	Union Oil Outfall	1988
M14	Point Pinole	1980-88;1990-91;1993
M15	Castro Cove Bridge	1988;1990
M16	Richmond Bridge	1980-82
M17	Santa Fe Channel	1986;1991
M18	Lauritzen Canal/Mouth	1985-88
M19	Lauritzen Canal/End	1986-88;1991
M20	Santa Fe Channel/End	1985-87;1991
M21	Richmond Harbor	1985-88
M22	Staufer's	1982
M23	Serl Intake	1991
M24	Point Isabel	1988
M25	Angel Island	1980-82
M26	Fort Baker	1981-82;1991;1993
M27	Alcatraz Island	1989
M28	Treasure Island	1979-83;1985-88;1990-91;1993
M29	Alameda Yacht Harbor	1985-88
M30	Oakland Inner Harbor	1986-87
M31	Embarcadero Cove	1985-88;1991;1993
M32	Lake Merritt	1992-93
M33	Oakland Back Harbor	1985-88
M34	San Francisco Outfall	1988
M35	Islais Channel	1987-88
M36	Hunter's Point	1981-82;1991;1993
M37	Hunter's Point/Shipyard	1988
M38	San Mateo Bridge/8B	1980-83;1985-87;1990-91
M39	San Mateo Bridge/8A	1982
M40	San Mateo Old Bridge	1982
M41	Belmont Slough	1982
M42	Redwood Creek	1981-83;1985;1991;1993
M43	Channel Marker 10	1982
M44	Redwood Creek/Towers	1982
M45	Tradewinds	1980;1982
M46	Redwood City/Outfall	1982
M47	Pete's Marina	1982
M48	Bair Island	1987
M49	Pulgas	1982
M50	San Francisco Airport	1982
M51	Dumbarton Bridge	1980-83;1985-88;1991
M52	Palo Alto Outfall	1988;1990
M53	Newark Slough	1982
M54	Channel Marker 17	1982
M55	Palo Alto	1982;1991;1993
M56	Palo Alto/Yacht Club	1982;1991
M57	Alviso Slough	1982
M58	Duxbury Reef	1979-81
M59	Muir Beach	1979
M60	Point Bonita	1980
M61	Farallon Islands	1977-78;1980
M62	Cliff House	1980
M63	Pacifica	1980
M64	J. Fitzgerald	1977-79;1981;1991
M65	Pescadero Creek	1988-89

TABLE 6-3 KEY TO FIGURE 6-3 STATE MONITORING NETWORK

State Toxic Substances Monitoring Stations

Code	Station	Sampling History
T1	Alameda Creek	1991-1992
T2	Alameda Creek	1985
T3	Alamitos Creek	1986-1988
T4	Almaden Reservoir	1988-1990
T5	Anderson Reservoir	1982
T6	Bear Gulch Reservoir	1989
T7	Calabazas Creek	1987-1989
T8	Calero Reservoir	1986
T9	Coyote Ck./ Brokaw Rd	1986-1989
T10	Coyote Ck./ Percolation	1990
T11	Coyote Ck./ Montague	1981-1984
T12	Coyote Reservoir	1983
T13	Dry Creek	1990
T14	Elmhurst Creek	1988
T15	Guadalupe Creek	1986
T16	Guadalupe Reservoir	1986
T17	Guadalupe River	1981-1984
T18	Guadalupe River	1986
T19	Lake Chabot	1989
T20	Lake Herman	1985-1986
T21	Lake Merced	1986
T22	Los Gatos Creek	1989
T23	Napa River/ Napa	1978-1979, 1990-1993
T24	New York Slough	1988
T25	Petaluma River	1992-1993
T26	San Leandro Creek	1986-1987
T27	San Pablo Creek	1985
T28	Sonoma Creek	1993
T29	Stevens Creek	1990-1992
T30	Stevens Ck. Reservoir	1989
T31	Suisun Bay	1986-1993
T32	Vasona Lake	1989-1990
T33	Walker Creek	1991-1993
T34	Walnut Creek	1991-1993